

NEW ZEALAND
PATENTS ACT, 1953

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COMPLETE SPECIFICATION

"Multifold Panel Assemblies"

We, FLETCHER ALUMINIUM LIMITED, a company duly incorporated under the laws of New Zealand of 7 Maui Street, Pukete Industrial Estate, Te Rapa, Hamilton, New Zealand, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

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The present invention relates to multi-fold window and/or door assemblies.

The present invention is directed to a multifold arrangement (whether top mounted or bottom mounted) adapted to lend itself to a more positive closure and a more secure closure compared to alternative procedures. For example, as disclosed hereinafter by reference to Figures 1 and 2 hereof, a typical prior art arrangement shown in plan for the closure of a door or window opening is that using a four panel arrangement. The prior art typically has required that the arrangement positioned at the distal pivot (A') requires the pivot point positioned forward (outside) the panel edge and therefore offset from the bifold carriage centre line. An example of this design is seen in New Zealand Patent Specification No. 229391.

The present invention is directed to an arrangement for at least a bi-fold panel (glazed or otherwise) structure, and whether for door or window purposes or a hybrid of both, whether top or bottom mounted (supported), which alone or in conjunction with a mirrored arrangement can provide an alternative to such an arrangement.

In a first aspect the present invention consists in a **multifold window and/or door assembly** of a kind having two or more window or door panels (glazed or otherwise) hinged together about a vertical axis and adapted, in a closed condition, to lie in the plane (hereafter "said plane") of a wall opening (at least in part) closably thereby,

wherein a first said window or door panel which is, at least in said closed condition, proximate a vertical periphery of said wall opening and is pivot supported by means providing a vertical pivot axis (the first panel pivot axis [preferably "A"]) disposed to that side of said plane to which that first panel is to open from said closed condition, and

a second said window or door panel connected to said first panel by means providing a vertical pivot axis (the first/second panel pivot axis [preferably "B"]) (which in the said closed condition) is disposed to that side of said plane opposite to that to which said first panel is to open thereby to facilitate, in the open condition, the pivoting of said second panel towards said first panel when both said panels are angled to said plane and said first/second panel pivot axis is further away from said plane than it is in said closed condition,

and wherein said second panel is tracked and pivoted at its distal vertical extremity (or thereabouts) by means that provides for the pivoting of said second panel out of said plane about a vertical pivot axis (the "distal pivot" of the second panel [preferably "C"]) in said plane.

As used herein the reference to "panel" in relation to multi-fold window and/or door panels is applicable to any substantially rigid panel form capable of being mounted

and/or interconnected from a related panel. The word "panel" includes within its scope composite structures (glazed or otherwise) and reference to "door and/or window" should be considered as being such that hybrid or composite structures are within the ambit of the term. Also structures of as few as two panels only are envisaged.

Where hereafter there is reference to top mounting of the panel it should be appreciated that the present invention extends to bottom mounted variants and even hybrids. Accordingly for simple reversed bottom mounted variants the arrangement should be considered as inverted.

Preferably said distal pivot axis is as far as possible to the "leading" edge of the second panel to minimise "scrub" as hereafter described.

Preferably said first panel pivot axis, said first/second panel pivot axis and said distal pivot are A, B and C as shown in the accompanying drawings.

Preferably a bogie carries said distal pivot axis is over or under the second panel back from the distal pivot axis.

Preferably said first panel pivot axis is non-tracked, i.e. is fixed in relation to the wall opening.

Preferably the tracking and pivoting of said second panel at its distal vertical extremity is at least above the panel and in line with the centre of a track arrangement (e.g. for a bogie or other means to carry said distal pivot/pivot axis. Most preferably however there is tracking both top and bottom even if only one of said tracks guides a bogie carrying the distal pivot axis e.g. the other could be a mere pin able to rotate in the other track yet be guidable thereby.

In some forms of the present invention, if desired, said first panel pivot axis can also be provided by means that is tracked, i.e. is capable of moving in alignment with or parallel to the tracking motion of the means that provides the distal tracking pivot support of said second panel.

Preferably the first/second panel pivot is not supported (even in the closed condition) by any tracking although there may be provision made for some latching or other engagement at or adjacent that axis, eg. of one or other of the panels or any interconnection there between with a structural member or a structurally dependent member.

In a most preferred form of the present invention the aforesaid arrangement characterised in respect of said first and second panels and the pivot mounting and interconnection thereof is reflected by a second such arrangement for the same wall opening whereby, for full opening of the wall opening, four panels are involved and as pairs they assume a similar folding possibility disposed on one side of said plane and, in

said closed condition, a pair of distal extremities (i.e. of said second panel and its mirrored complement) are in close proximity.

In still a further aspect the present invention consists in **a method of mounting a multi-fold door or window** which involves the use of pivot axis or axes and tracking or fixed mounting thereof in a manner substantially as hereinbefore described and/or substantially as hereinafter described with reference to any one or more of the accompanying drawings save for Figures 1 and 2.

For example, said mounting (top and/or bottom) includes a combination of A, B and C type axes, the C type axes being for distal mounting.

In still a further aspect the present invention consists in **a structure or assembly** closed by an assembly in accordance with the present invention or using a method in accordance with the present invention.

In still a further aspect the present invention consists in **a pivot providing unit** comprising a bogie for suspending or supporting a distal pivot of a structure as previously set forth and pivot providing means dependent therefrom being set to a position which is disposed (when fitted to a panel) is in advance of the pivot axes of the bogie wheels.

Preferably such a unit is substantially as hereinafter described with reference to Figure 9 of the accompanying drawings.

To those skilled in the art to which the invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the scope of the invention as defined in the appended claims. The disclosures and the descriptions herein are purely illustrative and are not intended to be in any sense limiting.

A preferred form of the present invention will now be described by reference to the accompanying drawings in which;

Figure 1 is simple plan view of a prior art closure assembly of four door or window panels for a wall opening, there being a grouping of two to one side and two panels to the other side, as shown in New Zealand Patent Specification No.229391.

Figure 2 shows the arrangement of Figure 1 in one of its several open conditions, such a prior art structure showing the group of two panels disposed to one side of said plane whilst the leaf panel is similarly preferably disposed to the same side of said plane and two panels to the other side,

Figure 3 is also a plan view depicting a prior art arrangement where the distal pivot axis "D" is in said plane but is set substantially back from the leading edge of the panel,

Figure 4 is a plan view of the arrangement of Figure 3 in one of its several open conditions,

Figure 5A is a close up side view of a bogie providing distal pivot axis "D" for the prior art arrangement shown in Figures 3 and 4,

Figure 5B is a plan view of the prior art bogie of Figure 5A,

Figure 6 is an arrangement similar to that of Figure 3 but being one in accordance with the present invention, there being a first and second panel as defined in respect of the present invention on one side of the wall opening being mirrored by a complement of two further panels on the other side of the wall opening,

Figure 7 shows the open condition of the arrangement of the present invention shown in Figure 6, Figures 6 and 7 being shown similarly to the drawing notation used for the prior art arrangements of Figures 1, 2, 3 and 4 and showing by letters

"A" a substantially vertical axis which is a preferred first panel pivot axis disposed on one side of said plane.

"B" a said first/second panel pivot axis on the other side of said plane to the pivot axis "A",

"C" a said distal pivot of the second panel in said plane, and

the distal pivot being directly in line with the centre line of the tracking arrangement (compared to the distal part of prior art being either offset to the outside [as shown in Figures 1 and 2] or in the plane but set substantially back from the leading edge of the second panel [as shown in Figures 3 and 4]),

Figure 8A is a plan view in more detail showing a preferred form of arrangement as shown in Figure 6 and 7 (open) (the glazed areas being substantially reduced in size to allow compaction of the panel frames),

Figure 8B shows an enlargement of part of Figure 8A,

Figure 9A is a similar arrangement to that shown in Figure 8A however one in which the interior side of the panels are dressed in timber facings, and

Figure 9B is an enlargement of part of Figure 9A,

Figures 10A and 10B are related drawings with the "X" of Figure 10A showing in plan the pivot axis of the distal pivot "C", the bogies of the distal panel pivot providing unit shown in Figure 12 simply being shown in plan in Figure 10A, the linking arrow between Figures 10A and 10B showing how the pivot axis is to overlies the pivot axis "C" in Figure 10B,

Figure 11A further illustrates in plan the leading edges of adjacent second panels in a four panel bifold assembly (closed condition), the pivot axis carrying units of Figure 12 being depicted by broken lines which are overlayed to emphasise the position of the pivot axis C in relation to the bogie, the dimension "d" shown to the left denoting the width of the frame seals,

Figure 11B is a similar arrangement to that of Figure 11A but in this case in relation to a door frame extrusion the position of which remains fixed in relation to the wall opening,

Figure 11C is yet another variant of the kind shown in Figures 11A and 11B, there being an additional hinged door panel to the right engageable with the extruded section forming the distal edge of the second bifold panel to the left,

Figure 12A is a perspective view of a preferred pivot providing unit including a bogie with a set of four wheels carrying a pivot axis defining member "C" capable of being located down the extrusions shown in Figures 11A, 11B or 11C, the lower member providing the means for tracking and pivoting the bottom of the panel about the same axis "C",

Figure 12B is an alternative embodiment to that of the preferred arrangement shown in Figure 12A, the pivot carrying bogie in this instance being inverted so as to engage the track at the bottom of the panel rather than the top, and

Figures 13A and 13B show how a reduced degree of scrub can be achieved by positioning the distal pivot axis further towards the leading edge of the panel, the extent of scrub in both cases being illustrated by an arc originating from the distal point "P", there being a scrub length " ℓ_{scrub} " related to the variables "x" and "y" defining the distance from the pivot axis to the ultimate scrub potential point "P" for a given angle θ that the second panel makes with said plane, and

Figure 14A, 14B, and 14C correspond to the arrangements depicted in Figures 11A, 11B, and 11C respectively, however the extent of scrub in each case has been illustrated in the form of an arc, as with previous drawings the dimension "d" has been shown to indicate the width of the frame seals.

In the preferred form of the present invention each of the door panels or window panels 1 is preferably a glazed panel framed by aluminium extrusions as at least intimated by the plan diagram shown in Figures 8A and 8B which show glazing panels 2 between extrusions shown in plan from above (the glazing panels being compacted to allow for clarity).

Persons skilled in the art will appreciate however that any such framed structure, even if dressed with timber facings 3 as shown in Figures 9A and 9B, still accords with the present invention irrespective of whether or not pivot arrangements as depicted in Figure 7 and/or the prior art patent specification referred to might be utilised.

It is envisaged in accordance with the present invention that each pivot axis "A" is fixed relative to the wall but in some forms of the present invention these can be tracked to allow disposition of all of the panels to one side of the wall opening. Each pivot axis

"B" is not tracked in any way and is a simple hinging arrangement providing an axis displaced from said plane shown in Figures 6 and 7 by the broken line.

The arrangement provided at "C" locks the structure into a tracking relationship. Such tracking can be in the plane or can be offset from the plane provided however the pivot axis "C" provided by the means dependent from the track is in or at least substantially in said plane, i.e. is not displaced to the same extent from said plane as the pivot axes "A" and "B".

The axis "C-C" shown in Figure 12A is the pivot axis "C" shown in Figures 10A and 10B. Wheels 4 in a known way carry a member adapted to be fitted to the door or window panel. In this case however the pivot "C" is provided as far as possible to the right of the extrusions shown in Figures 11A, 11B and 11C as extrusions 5, 6, and 7 respectively.

The reasons for this emphasis on placement of the pivot axis as far as possible to the edge of the panel (or at least the extrusion 5, 6, or 7 thereof) is to minimise "scrub" owing to the arcuate movement of the distal point "P". There is a practical maximum allowable scrub that relates to the width of the door seal region 10 shown in Figures 14A, 14B and 14C. When the scrub exceeds this width the door will impinge upon the door frame 13 resulting in the door becoming jammed. Practical measures to alleviate this problem have, in the past, involved cutting the lower part the flange which in turn compromises the seal.

Within the present invention, different degrees of "scrub" are experienced for the various bifold arrangements shown in Figures 11A, 11B, and 11C. In each case the differences can be attributed to the positioning of the distal pivot axis "C" in relation to the distal point "P". For example, the panel 8 and seal 9 at the leading edge shown in Figure 14A will "scrub" into the frame seals 10 during opening and closure to a greater extent than the arrangement shown in Figure 14B where the scrub effect is largely mitigated due to the removal of the seal. In fact the extent of scrub for the arrangement shown in Figure 14B is so minimal that the leading edge needs to be magnified (as shown) to adequately visualise the path taken by the point "P" during opening and closure. For the arrangement shown in Figure 14C, the degree of scrub is governed by the length of the flange 11. Even with the placement of the member 12 of the bogied pivot defining unit shown in Figure 12A in the rebate or channel of the extrusions 5, 6, or 7, there is still a degree of scrub which has been reduced by moving the pivot axis "C" closer to the ultimate extent leading edge of the panel.

Persons skilled in the art will appreciate the advantages to arise from top mounting and/or bottom mounting multifold panels using a combination of A, B and C axes over a

mere combination of A and B axes.

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WHAT WE CLAIM IS:

1. **A multifold window or door assembly** of a kind having two or more window or door panels (glazed or otherwise) hinged together about a vertical axis and adapted, in a closed condition, to lie in the plane (hereafter "said plane") of top and bottom tracking of a wall opening (at least in part) closably thereby,

wherein a first said window or door panel which is, at least in said closed condition, proximate a vertical periphery of said wall opening and is pivot supported by means providing a vertical pivot axis (the "first panel pivot axis") disposed to that side of said plane to which that first panel is to open from said closed condition, and

a second said window or door panel connected to said first panel by means providing a vertical pivot axis (the "first/second panel pivot axis") which, in the said closed condition, is disposed to that side of said plane opposite to that to which said first panel is to open thereby to facilitate, in the open condition, the pivoting of said second panel towards said first panel when both said panels are angled to said plane and said first/second panel pivot axis is further away from said plane than it is in said closed condition,

and wherein said second panel is tracked and pivoted in said plane sufficiently close to its distal vertical extremity (if not there or there beyond) to reduce "scrub" as hereinbefore defined in said tracking during opening and closing by means that provides for the pivoting of said second panel out of said plane about a vertical pivot axis (the "distal pivot" of the second panel).

2. **A multifold window or door assembly** of a kind having two or more window or door panels (glazed or otherwise) hinged together about a vertical axis and adapted, in a closed condition, to lie at least substantially in the locus of top and bottom tracking (hereafter "said locus") of top and bottom tracking of a wall opening (at least in part) closably thereby,

wherein a first said window or door panel which is, at least in said closed condition, proximate a vertical periphery of said wall opening and is pivot supported by means providing a vertical pivot axis (the "first panel pivot axis") disposed to that side of said locus to which that first panel is to open from said closed condition, and

a second said window or door panel connected to said first panel by means providing a vertical pivot axis (the "first/second panel pivot axis") which, in the said closed condition, is disposed to that side of said locus opposite to that to which said first panel is to open thereby to facilitate, in the open condition, the pivoting of said second panel towards said first panel when both said panels are at least partly in their open condition and said first/second panel pivot axis is further away from said locus than it is

in said closed condition,

and wherein said second panel is tracked and pivoted in said locus sufficiently close to its distal vertical extremity (if not there or there beyond) to reduce "scrub" as hereinbefore defined in said tracking during opening and closing by means that provides for the pivoting of said second panel out of said locus about a vertical pivot axis (the "distal pivot" of the second panel).

3. An assembly of claim 1 or 2 wherein said first panel pivot axis, said first/second panel pivot axis and said distal pivot are A, B and C as shown in the accompanying drawing.

4. An assembly of claim 1, 2 or 3 wherein the tracking accomodates in part said second panel with a seal of thickness d interposed between said second panel and said tracking on the scrub potential side of said second panel, the location of said distal pivot axis, in relation to the ultimate scrub potential extremity P of said second panel, ensures that ℓ_{scrub} is less than or equal to d, where ℓ_{scrub} is characterised by the expression:

$$\ell_{\text{scrub}} = \sqrt{x^2 + y^2} (\theta - \tan^{-1}(x/y)) - y$$

where ℓ_{scrub} is the scrub length, and

x corresponds to a component of distance between said distal pivot axis and the scrub potential extremity P projected onto a plane defined by said second panel, and

y corresponds to a component of distance between said distal pivot axis and the scrub potential extremity P projected onto a plane defined orthogonal to said second panel, and

θ is the angle that said second panel makes with said plane during opening/closing.

5. An assembly of any one of claims 1 to 4 wherein a bogie carries said distal pivot and said bogie is substantially all over or under the second panel back from the distal pivot axis.

6. An assembly of any one of claims 1 to 5 wherein said first panel pivot axis is non-tracked, i.e. is fixed in relation to the wall opening.

7. An assembly of any one of claims 1 to 6 wherein the tracking and pivoting of said second panel at its distal vertical extremity is at least above the panel and in line with the centre of a track for a bogie or other means to carry said distal pivot.

8. An assembly of any one of claims 1 to 7 wherein there is tracking both top and

bottom and said distal pivot is tracked in each, at least one track guiding a bogie.

9. An assembly of any one of claims 1 to 5 wherein said first panel pivot axis is provided by means that is tracked, i.e. is capable of moving in alignment with or parallel to the tracking motion of the means that provides the distal tracking pivot support of said second panel.

10. An assembly of any one of the preceding claims wherein the first/second panel pivot is not supported (even in the closed condition) by any tracking although there may be provision made for some latching or other engagement at or adjacent that axis, eg. of one or other of the panels or any interconnection there between with a structural member or a structurally dependent member.

11. An assembly of any one of the preceding claims **characterised in** that said first and second panels and the pivot mounting and interconnection thereof is in combination with, and is reflected by, a second such arrangement for the same wall opening **whereby**, for full opening of the wall opening, four panels are involved and as pairs they assume a similar folding possibility disposed on one side of said plane and, in said closed condition, a pair of distal extremities (i.e. of said second panel and its mirrored complement) are in close proximity.

12. **A method of mounting a multi-fold door or window assembly** which involves the use of pivot axis or axes and tracking or fixed mounting thereof in a manner substantially as hereinbefore described with reference to any one or more of the accompanying drawings save for Figures 1, 2, 3 and 4.

13. A method of claim 12 wherein said mounting (top and/or bottom) includes a combination of A, B and C type axes, the C type axes being for distal mounting.

14. **A structure or assembly** closed by an assembly of any one of claims 1 to 10 or using a method in accordance with claim 12 or 13.

15. A mounted panel assembly substantially as hereinbefore described with reference to any assembly of any of the accompany drawings.

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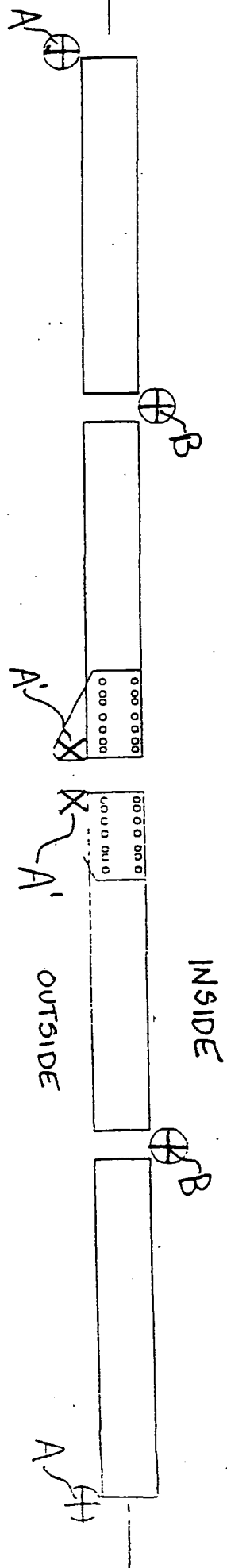


Figure 1 (prior art)

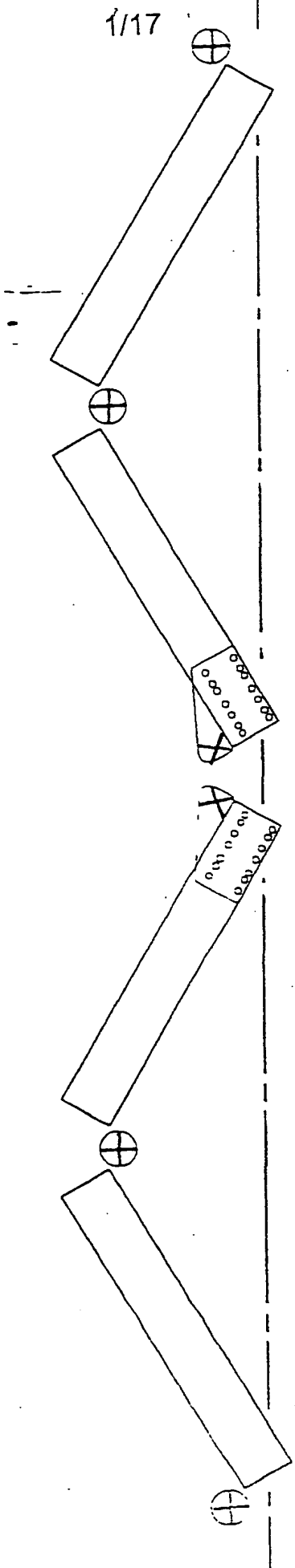


Figure 2 (prior art)

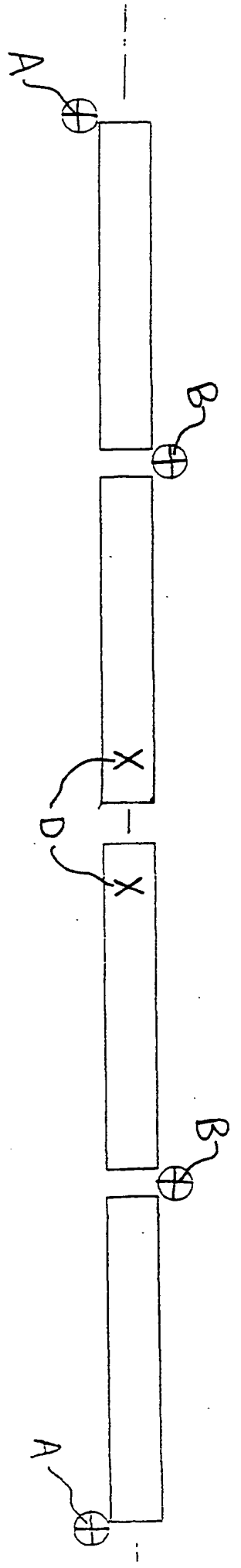


Figure 3 (prior art)

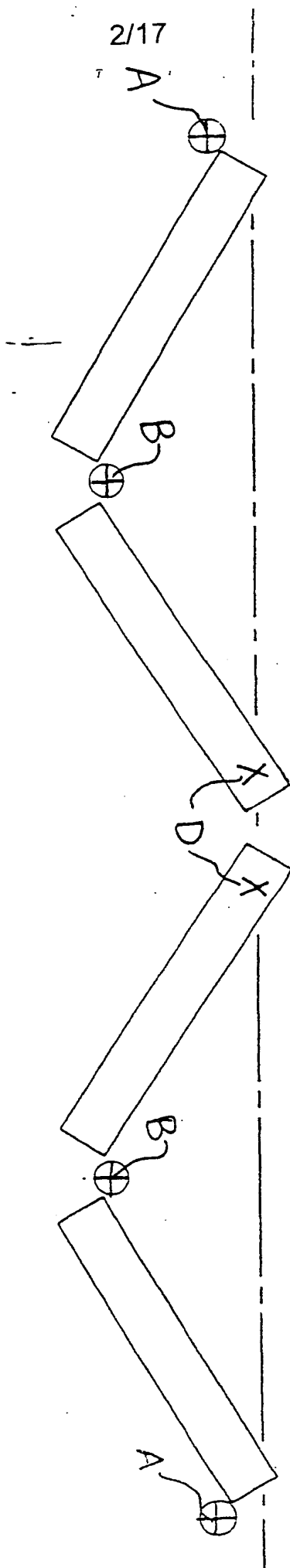


Figure 4 (prior art)

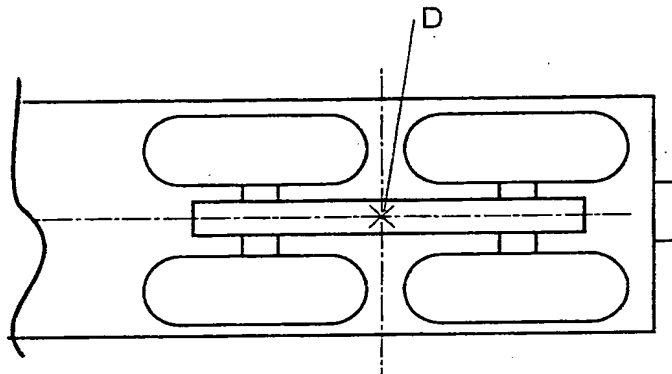


FIGURE 5B

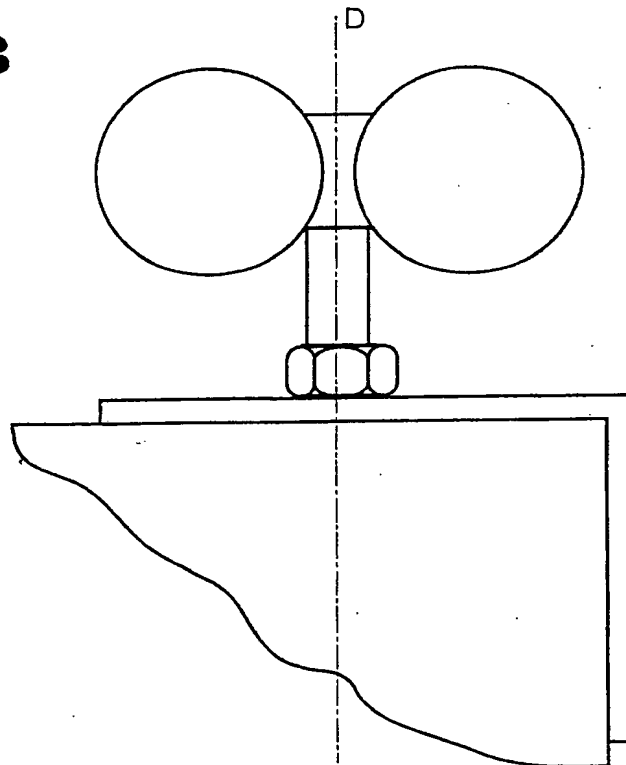


FIGURE 5A

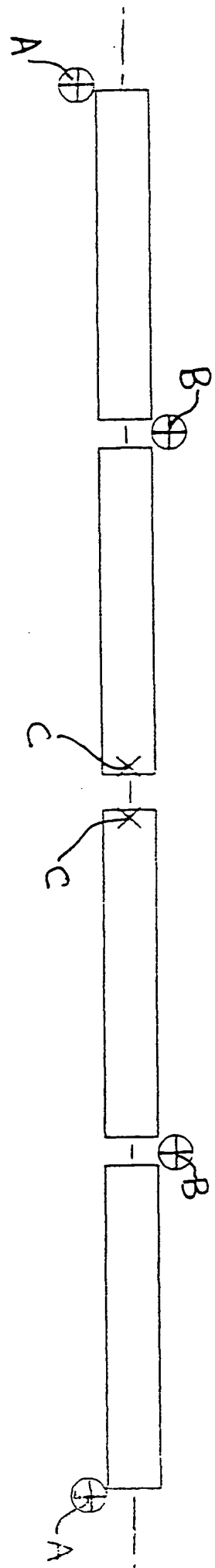


Figure 6

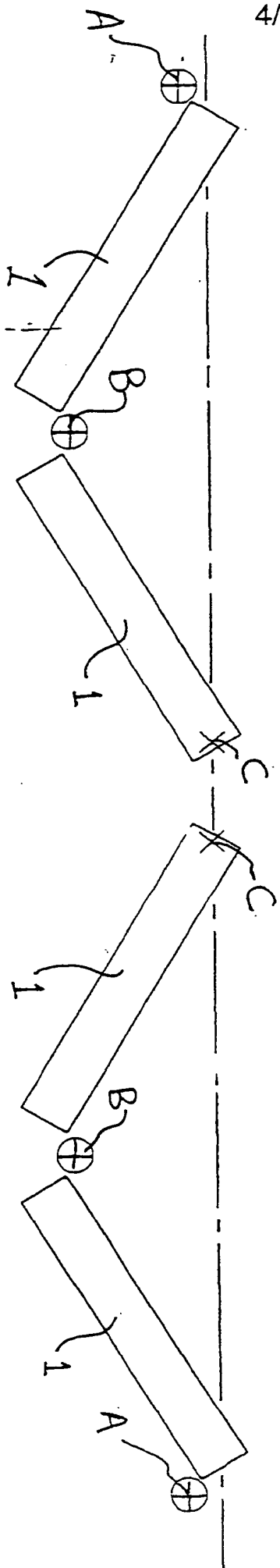


Figure 7

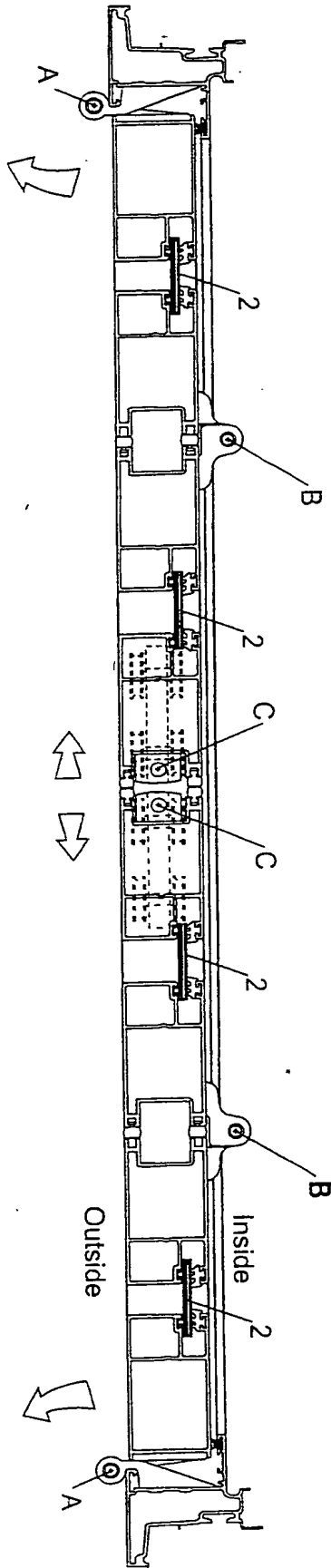


FIGURE 8A

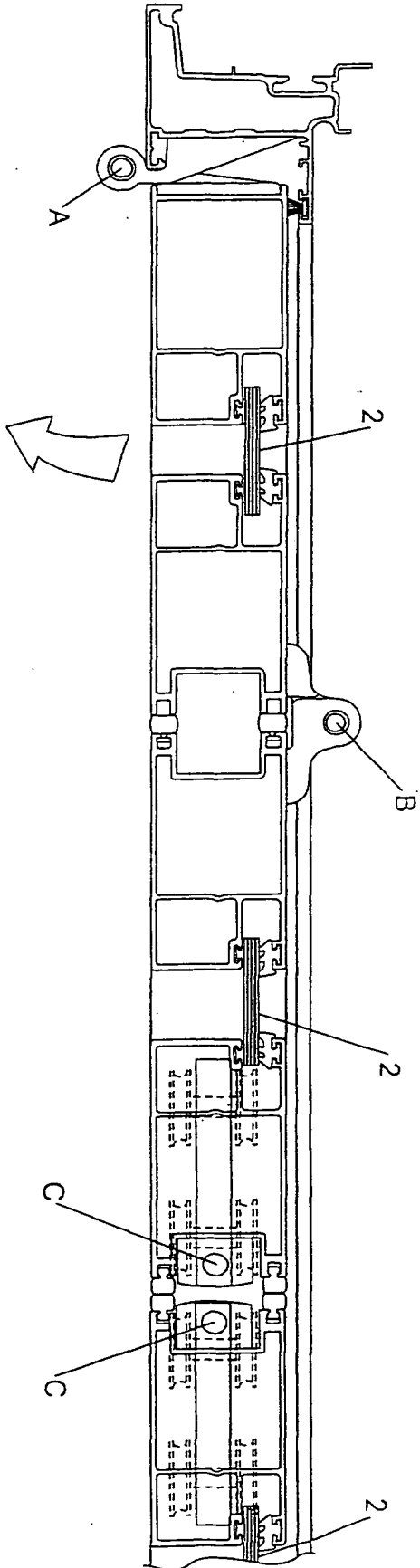


FIGURE 8B

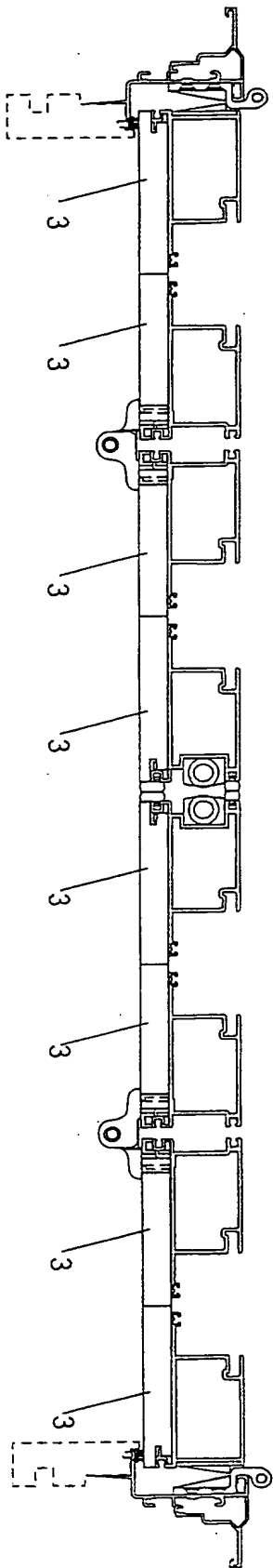


FIGURE 9A

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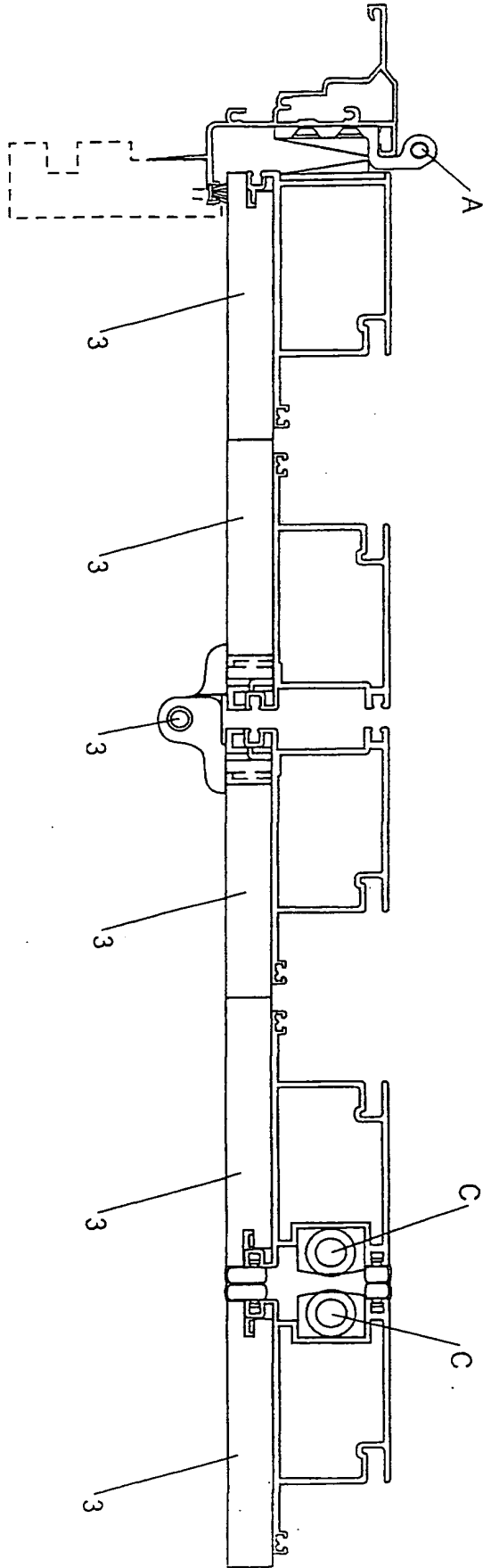


FIGURE 9B

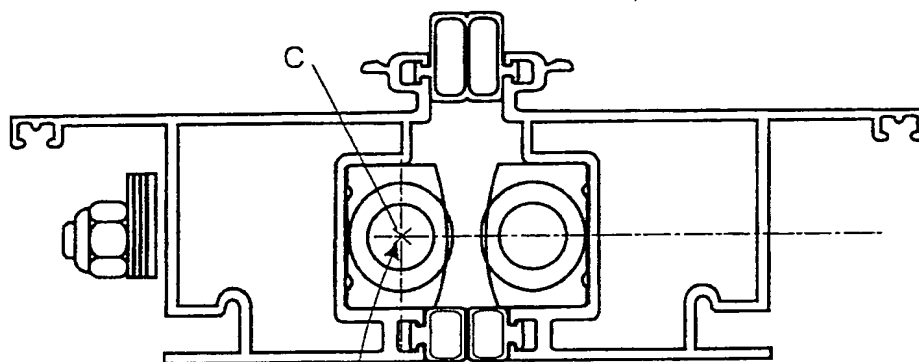


FIGURE 10B

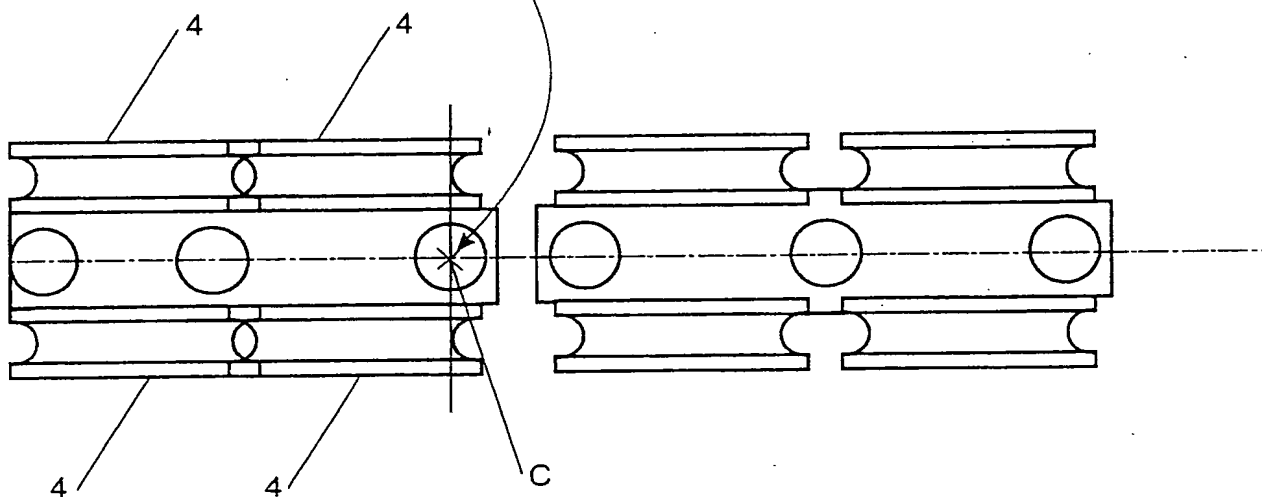


FIGURE 10A

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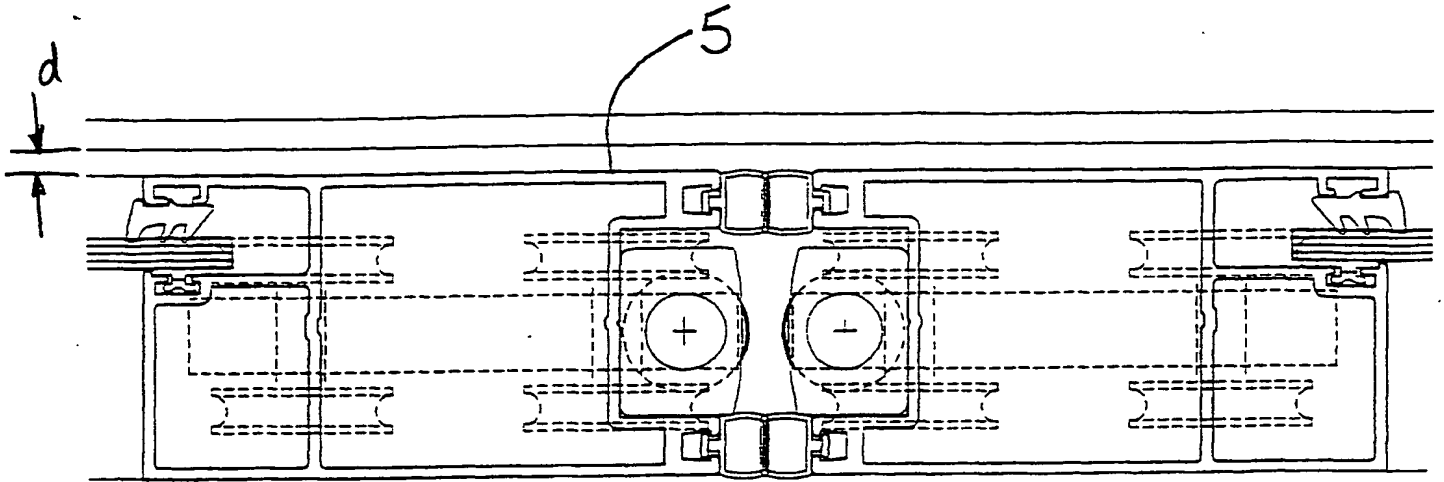


Figure 11A

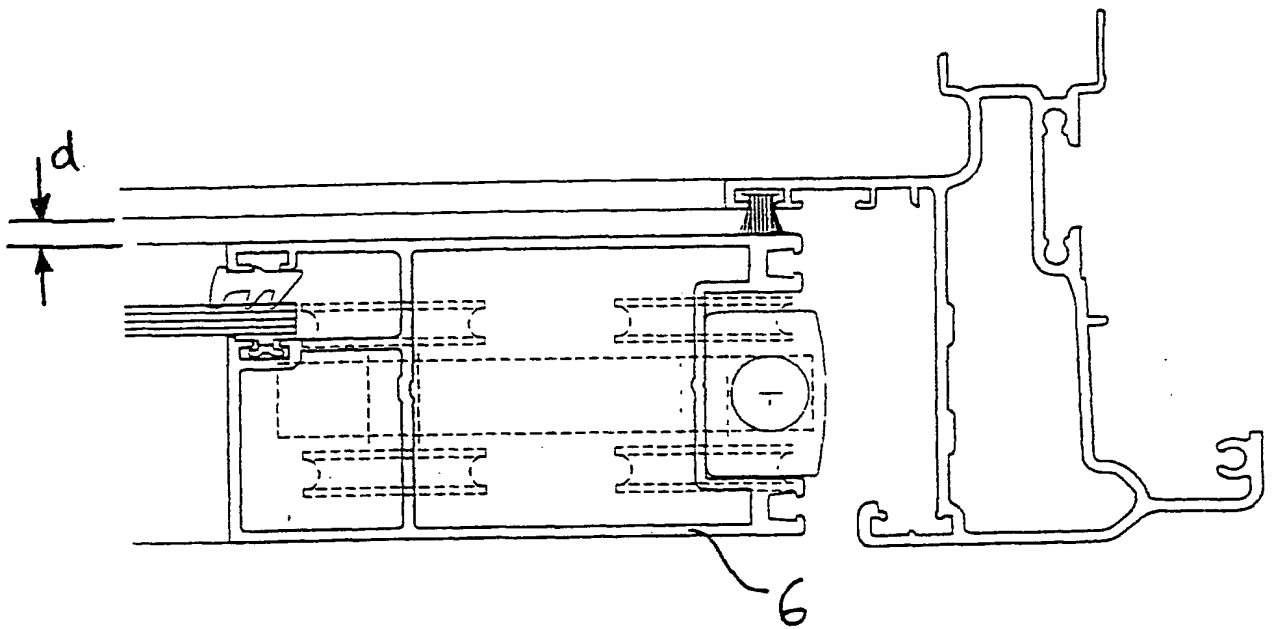
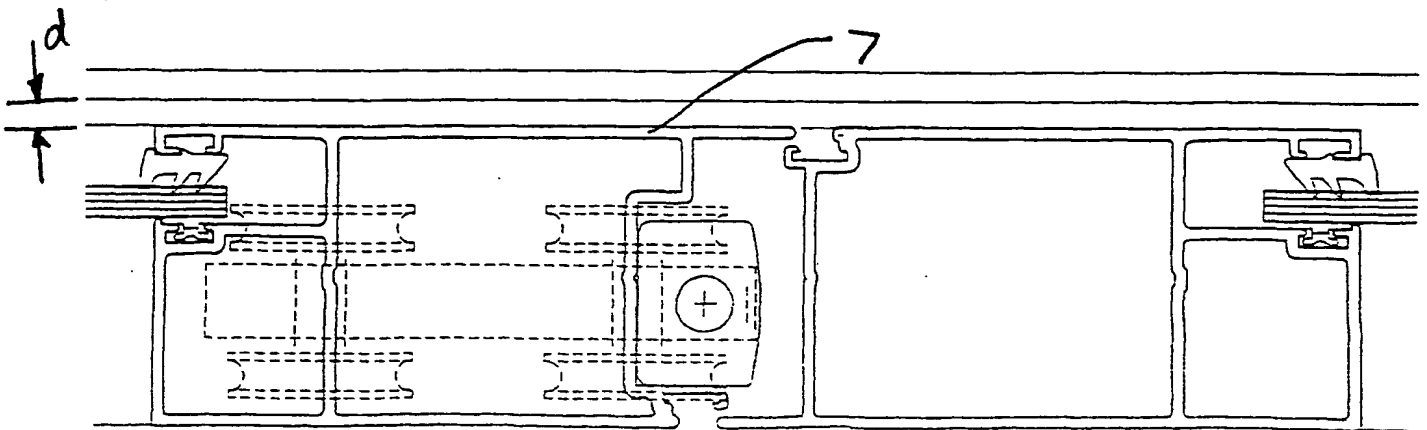


Figure 11B



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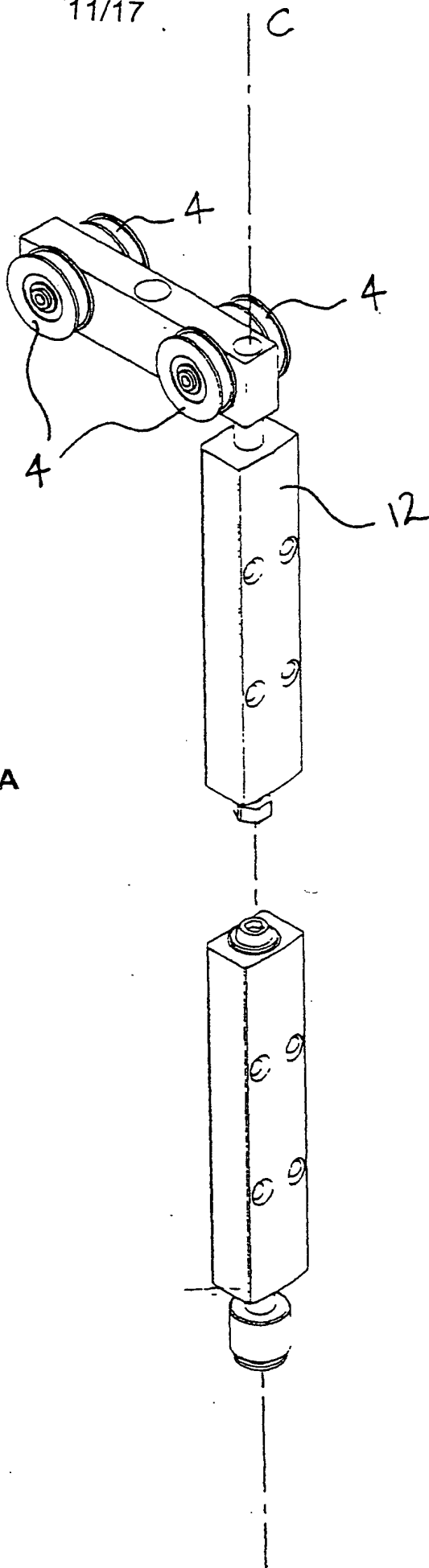
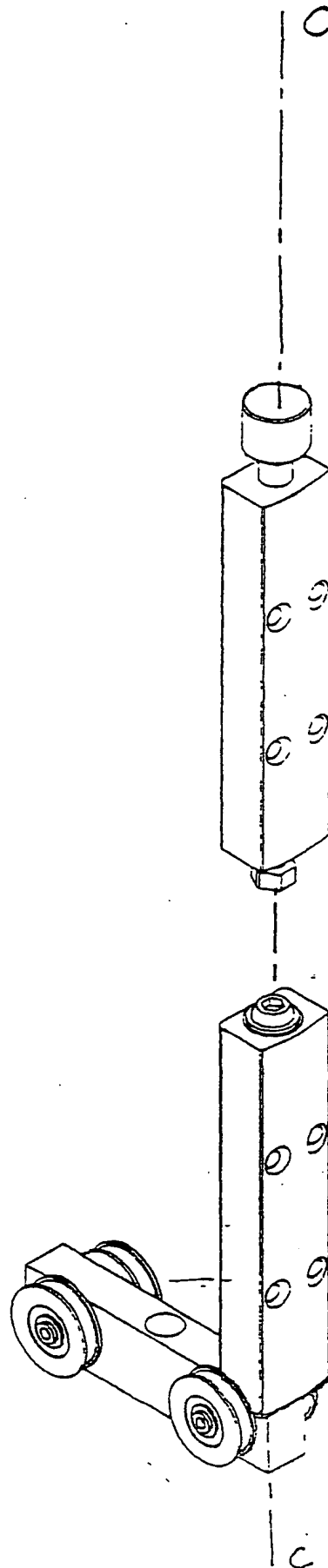


Figure 12A

Figure 12B



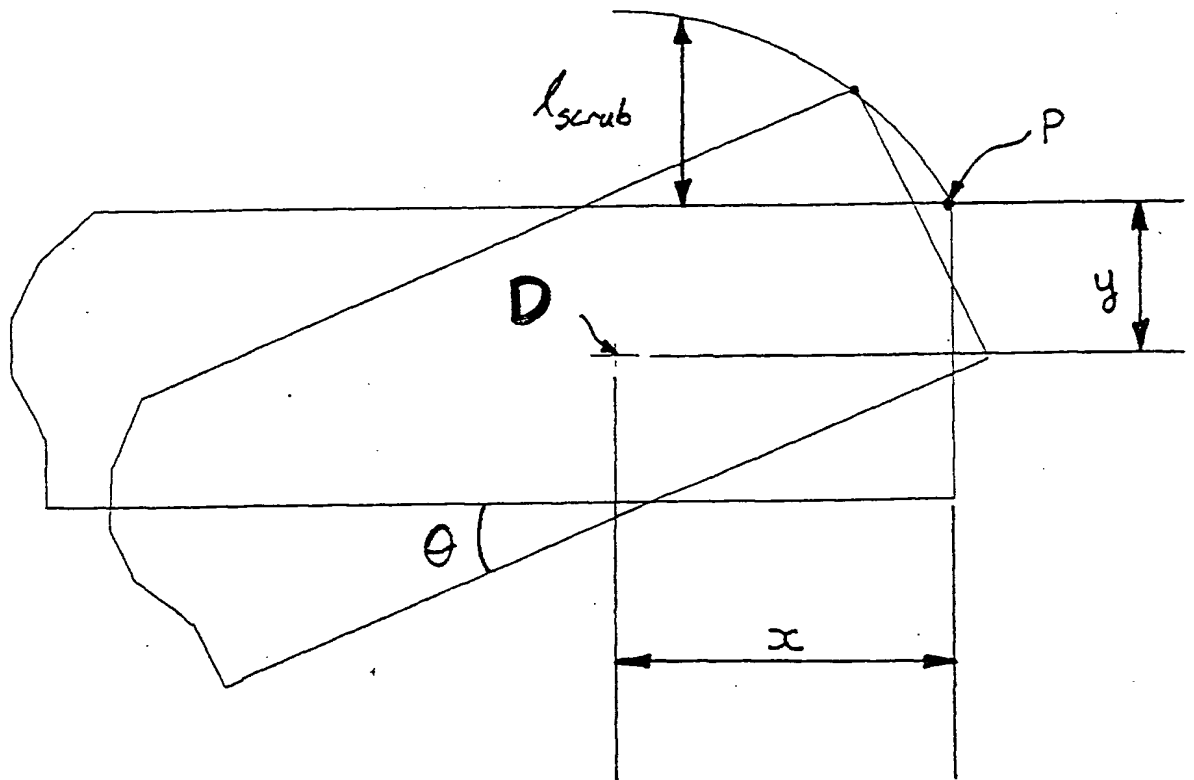


Figure 13A

$$l_{scrub} = \sqrt{x^2 + y^2} \left[\theta - \tan^{-1} \left(\frac{x}{y} \right) \right] - y$$

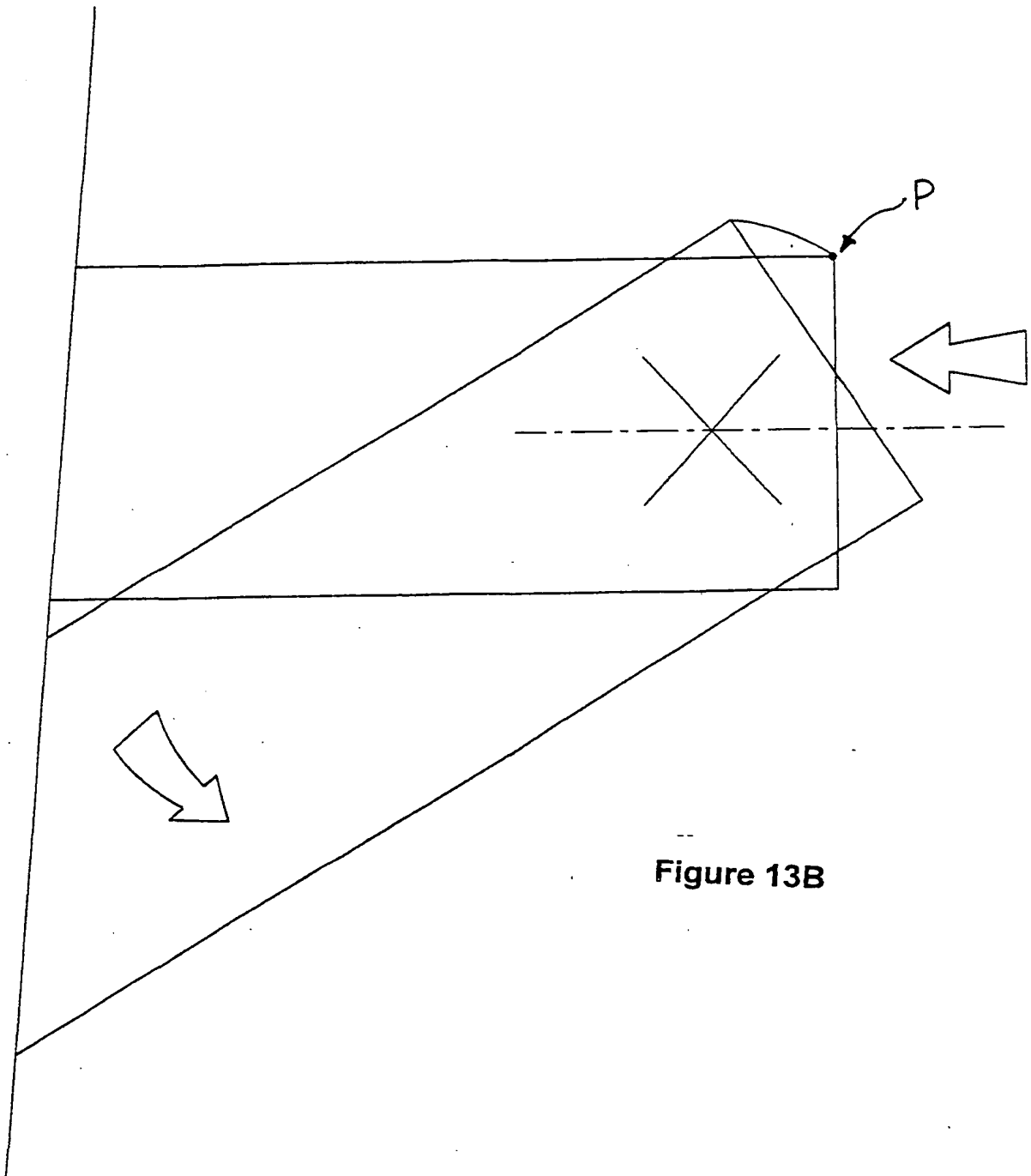


Figure 13B

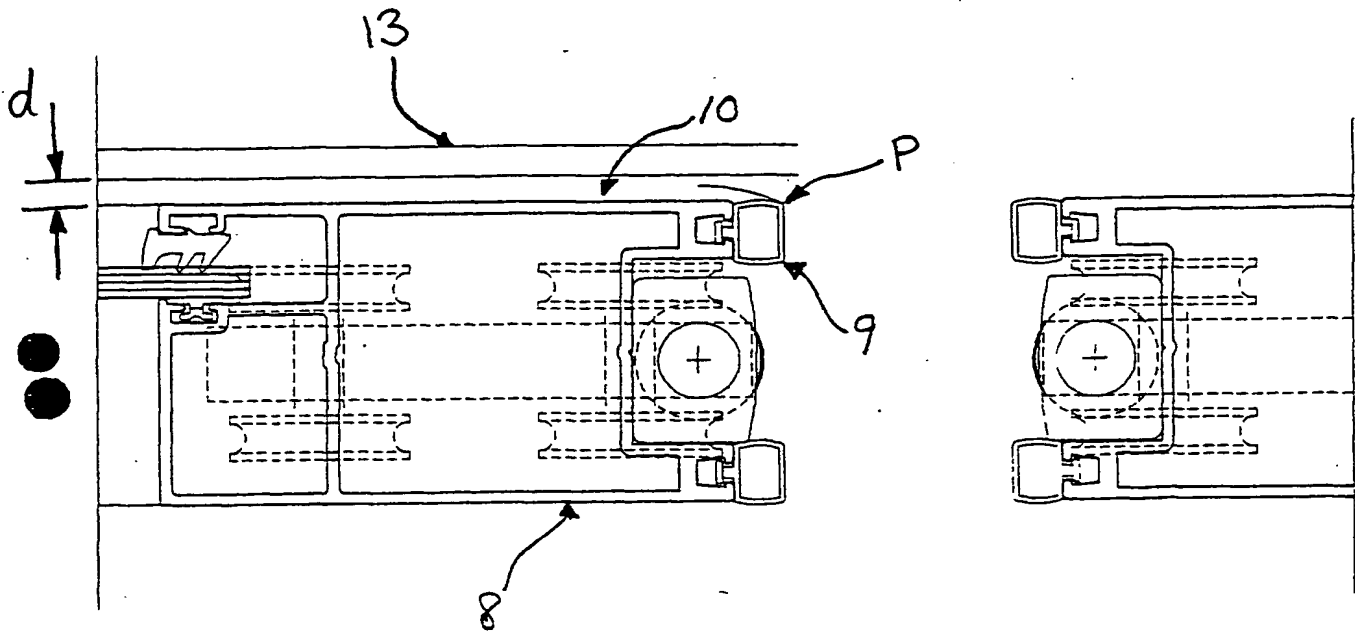


Figure 14A

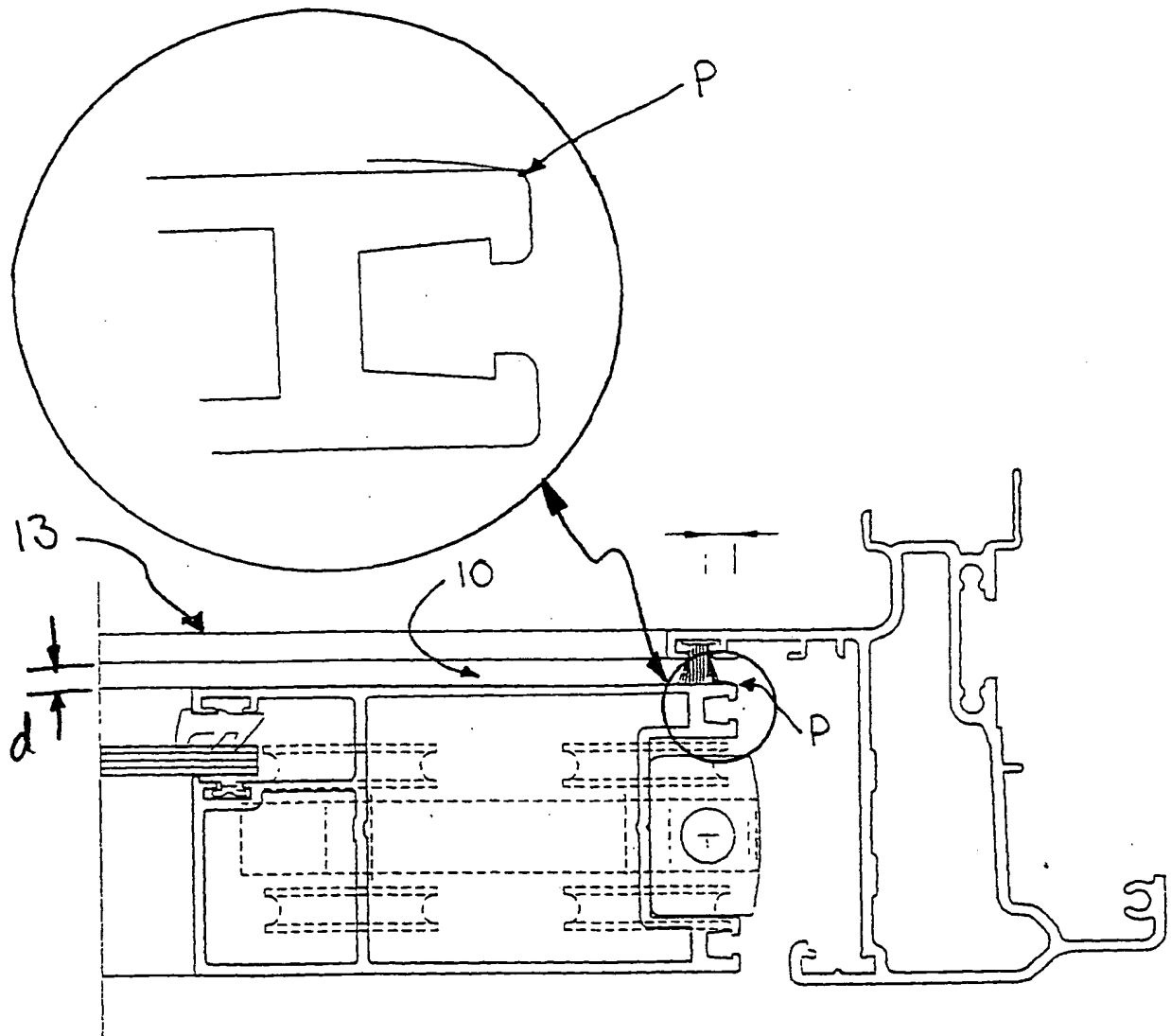


Figure 14B

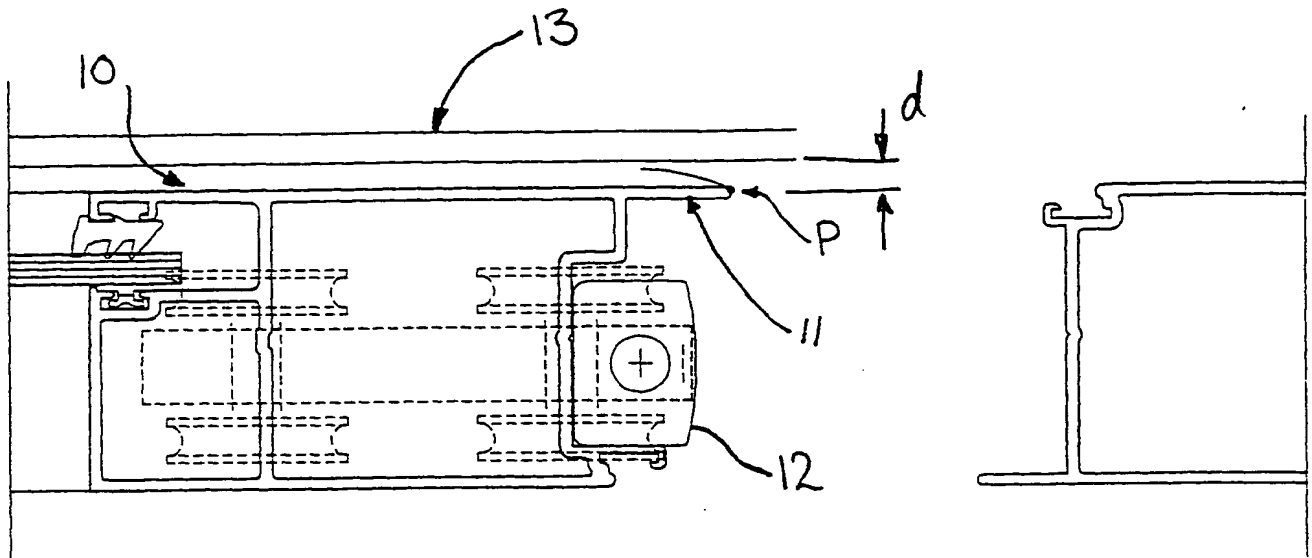


Figure 14C

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